ONTARIO FISH AND WILDLIFE REVIEW

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ONTARIO

DEPARTMENT OF LANDS AND FORESTS

HON. RENE BRUNELLE, MINISTER

W. Q. MACNEE, DEPUTY MINISTER

ONTARIO FISH AND WILDLIFE REVIEW

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THE COVER

Plankton sampling is normally carried out by towing nets behind boats, but only a Scuba diver can work so close to the bottom of the lake. The cover photo is only one item in the Sublimnos story told by Dr. Emery with pen and camera, Page 3. The back cover is his underwater, through-the-window shot of two Sublimnos inhabitants: Hon. Rene Brunelle, Minister of Lands and Forests, and Bill Henry, research diver.

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A Feel for the Land

How can we foster deep respect and loving understanding for the open land around us—we have degraded so much of our land. Before the loss increases, it is important that we instill in everyone an abiding respect for the land and the many forms of life that exist upon it.

We can talk about and read about the wonders of nature, but there is a feel for the outdoors that comes only from personal experience or from personal contact with someone who has that mystical ability to instill in people a simple awe for the outdoors.

We should cultivate an understanding of what it means to walk along a forest trail and listen to wind or chickadee or squirrel and become conscious that we are one with Nature and an integral part of a living environment. This is a personal revelation and must well up from within one's own being. Such insight cannot be forced; it must be nurtured.

Perhaps it is time that our natural science courses incorporated a philosophical approach and begin to extoll the simple beauties of the natural environment.

An enthusiasm for the land and its life forms must be genuine and needs to be based on more than fact. True, facts are necessary, but man is a "feeling" being as well as a "knowing" being. That is, both the rational and irrational aspects of man's nature must be considered when attempting to instill a feel for the land . . . A blending of the poet and scientist.

—A. A. Wainio

Sublimnos, on display outside the Royal Ontario Museum before becoming the first underwater habitat in freshwater. Through the side window (one of four), the overhead dome can be seen.

SUBLIMNOS

Text and Photos by Alan R. Emery
Research Branch

I have often wished I could become a fish and infiltrate the fishy society. The possibilities for research would be endless!

On June 24, 1969, such possibilities became reality when Sublimnos was submerged in Georgian Bay near Tobermory.

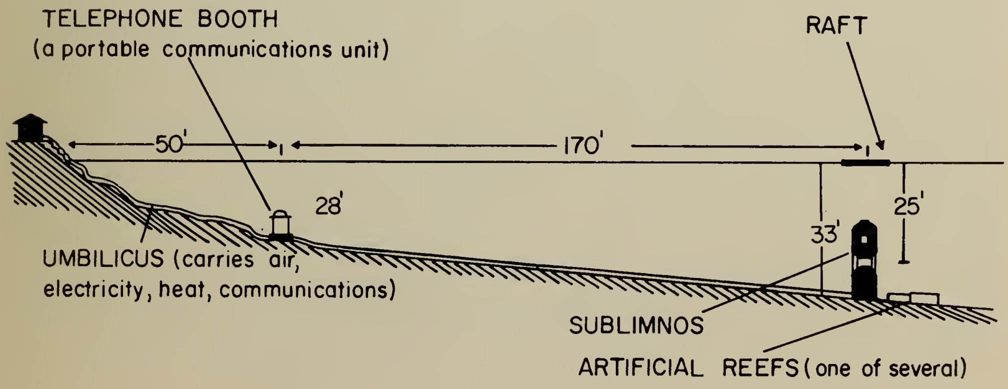
Sublimnos is unique in being the first Canadian underwater habitat and, in fact, the first one in freshwater anywhere in the world. By August, 1971, it had set a world record of twenty-six months of continuous operation.

Built from the bottoms of two pressure-tested ore carriers, the habitat is basically two hollow cylinders, each eight feet high and eight feet in diameter, joined one on top of the other by steel girders. The lower cylinder houses the seven tons of steel ballast used to keep it down, and the upper one contains the life support and scientific equipment.

Sublimnos was developed by Dr. Joseph B. MacInnis, a Toronto physician specializing in hyperbaric physiology—the functioning of the body under pressure. This knowledge led him to the United States programs involving underwater habitats designed to solve SCUBA (self-contained underwater breathing apparatus) and very deep, diving problems.

Despite the advantages of SCUBA diving, man is still a fish out of water. If he dives too deep or stays below too long, he may suffer painful and sometimes fatal consequences—the dreaded bends.

One way of avoiding this problem of returning after an extended dive is to remain on the bottom. At any depth, after a prolonged period of time, the body becomes saturated with nitrogen and, regardless of further time spent at that depth, no increased decompression time accumulates. This requires living under water and under pressure, and the problems involved are Dr. MacInnis' research specialty. Until 1969, investigations of such problems proved



Sublimnos habitat and underwater work area as it was in December, 1969.

extremely expensive. In 1968, after touring an American-designed underwater habitat off the Florida coast, Dr. MacInnis conceived the idea of an inexpensive habitat to be built in Canada for the use of scientists other than engineers.

Sublimnos was first displayed for over a month in front of the Royal Ontario Museum in Toronto. From there, it was moved to Tobermory, Ontario, for submergence in a 35-foot depth of the cool, rock-bound waters of Georgian Bay.

The first days were very difficult. The compressor, pumping air to the habitat, often stalled; the polyurethane insulating material in the habitat required about a month under water to cure before it adequately kept out the cold; the windows were always fogged (until we thought of using a wetting agent to clear them); and there was a constant, often annoying string of unannounced, if well-intentioned, visitors.

Gradually, new gadgets were acquired, and better ideas evolved. Facilities now include a road to the shore and a small shack for dressing and storage of a variety of gear including communication equipment. Beside this shack, there is an electric, low-pressure compressor to pump air to the habitat; a bank of high-pressure air storage cylinders, connected to a large compressor so that aqualungs can be filled at the shoreline; and a hot-water heating system.

Under water, a complex of lines carries air, hot water, and communications to Sublimnos. It is interrupted at the 25-foot depth by a small communications unit—a plastic hemisphere trapping a bubble of air into which a diver can pop his head and speak to shore, to the habitat 250 feet off shore, or to another diver beside him. Farther off shore, the habitat looms out of the green, surrounded by installations of long-term scientific investigations. Inside are several desks, a circular bench, lights, gas monitoring devices, and temperature gauges.

Sublimnos and its supporting facilities have been provided free of charge, and diving scientists have been especially urged to utilize it. Primary scientific and financial support has come from the National Geographic Society, the Canadian National Sportsmen's Show, and the Ontario Department of Lands and Forests; but many groups have contributed. As a result, 1,000 divers have visited the site. Sublimnos has served as a temporary scientific platform for representatives of over ten institutions, including in Canada those from as far away as Memorial University of Newfoundland, and in the United States from as far away as Texas A & M.

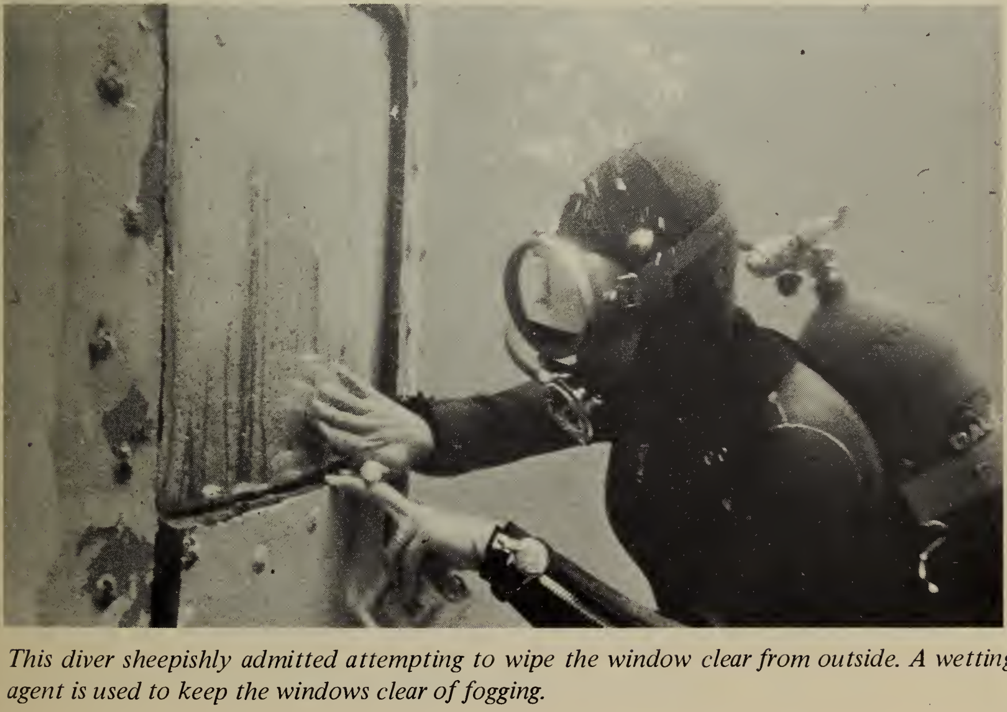
Work carried out has encompassed a series of studies including estimates of fish populations, measurements of the rates of *in situ* production of benthic algae, a study of the spatial distribution of microbenthic invertebrates, a time study of the behavior and ecological relationships of certain populations which showed variations between day and night periods, and an evaluation of two methods of underwater mapping which proved applicable to areas of moderate-to-good underwater visibility.

These studies showed that the habitat-based diver can effectively improve both the use of his active work time and the efficiency with which he undertakes each task by a factor of two to three over a surface-supported free diver, when working on *selected* experiments. In addition, some studies can only be made by divers provided with the habitat-type support.

Another area of scientific study carried on at Sublimnos is that of bio-engineering. This study is an attempt to investigate those kinds of equipment which will best support man under water the year round. Breathing devices, heated suits, navigation and propulsion devices, as well as photographic and recording instruments, are among the apparatus under study.

Dramatic confirmation, that direct and long-period observation under water would yield new, even unexpected, information,

Sublimnos is entered through a vertical and completely open hatchway, visible behind and above the diver. A diver removes his aqualungs outside, hangs them on the exterior wall, and swims six feet to the hatchway, holding his breath.



This diver sheepishly admitted attempting to wipe the window clear from outside. A wetting agent is used to keep the windows clear of fogging.

At 25-foot depth is an underwater "telephone booth" into which one or two divers can pop their heads to speak to the shore, Sublimnos or each other.

occurred on the night of August 14, 1969.

I had been directing a 24-hour plankton collecting station, which involved swimming and towing a net as close to the bottom as possible. Beautifully clear warm water had greeted us each time we left Sublimnos for the next sample. At 10:00 p.m., I slipped out of the hatch into the blackness of underwater night and, as I dropped to the lake floor, a layer of icy water closed in on me. Quickly I turned on my flashlight. A dull glow was the only response. Swimming back up, I could see that the water in this layer was very murky as well as very cold. My team completed the now uncomfortable sampling and retreated to the warmth of Sublimnos.

We watched through the windows as the cold, dirty water rose and many fish left the artificial reef we had built to attract fish for study purposes. After donning extra wet suit equipment, we began a series of observations which showed us that some of the animals were more than just uncomfortable–they were dying. About four hours later, the cold water left, and we surveyed several representative areas, and by 4:00 a.m. it was evident that this naturally-occurring "thermal pollution" had killed many of the bottom-living and slow-moving crayfish and sculpins!

Technically, the phenomenon which caused this cold water upwelling is called an internal seiche. Most deep lakes are thermally stratified in the summer–the upper layer warm, the deeper layer cold. The narrow interface (thermocline) was moving up and down in the form of a giant underwater wave. These waves are not easily detectable from the surface. I estimated this one to be over 100 feet high at its origin far out in the bay!

It is significant that, for four months of the year, the area in which Sublimnos is located is covered with ice and simulates an Arctic situation. It is beneath the ice that the shallow water concept has unquestioned merit and may find its greatest usefulness. It provides a safe refuge and comfortable platform under those most difficult diving circumstances. It is hoped that, in the near future, habitats such as Sublimnos will be used in the Arctic for study.

Underwater habitats such as Sublimnos are probably of most value to biologists and ecologists but, even in these disciplines, there is room for improvement in operational techniques. Simple habitats like Sublimnos are economically feasible for universities and research agencies to own and operate. The scientific return should be more than sufficient to justify the expense.

Thousands of man-hours have been logged at Sublimnos, returning a high yield of scientific information from the natural history and bio-engineering studies, and from the co-operative underwater research programs. It has encouraged at least one similar habitat program at Memorial University, St. John's, Newfoundland, and also at Ontario's new underwater park, Fathom Five.

If their efforts continue to encourage people to appreciate Canada's aquatic resources, the founders of Sublimnos will be satisfied.

A research diver uses a "counting board", a simple recording device to estimate the abundance of several species of plankton at the same time.

An artificial reef of concrete blocks was built near Sublimnos on a barren plain of sand. It attracted a great many animals, particularly at night.

A Sublimnos diver prepares to enter the "inviting" ice water.

A diver-photographer investigates the undersurface of the ice. Bubbles of air from his exhaust form under the ice and eventually freeze there.

A diver returns to the hole in the ice. Visible above are a flashing beacon and a safety-line that leads to Sublimnos.

The lake smelt (Osmerus mordax) *is one of the few species that are able to school at night. Smelt feed on plankton.*

The ninespine stickleback (Pungitius pungitius) *is a small but effective predator on bottom-living crustaceans.*

SAFETY TRAINING PAYS OFF!

by A. E. Swanstrom
Supervisor of Hunting Licence Examinations, Wildlife Branch

Hunting is a safe sport today. In the past decade, as the number of hunters has increased, the accident rate has had an impressive decline. Why? Our educational program must be given at least part of the credit.

In Ontario, hunter education dates from 1957 when safety training was begun on an organized basis by member clubs of the Ontario Federation of Anglers and Hunters. Other clubs and individuals rallied in support of this public service to give the same safety course as prescribed by the Department of Lands and Forests. Beginning in 1960, a new hunter was required to complete the training successfully before he could buy his hunting licence. In 1961, careless hunting became an indictable offence.

The need for up-grading, and the uniformity of, instruction led in 1968 to the Department's standard examination for new hunters, combining written and practical tests which an applicant must pass before he may buy his first licence.

Young hopefuls, aged 15 to 19 years, are required to take the prescribed training course before they may sit for the examination. Older hunters are encouraged to take the course, and many of them join the juniors to brush up on gun handling and field behaviour.

Since the beginning of hunter safety training, the quality of instruction has improved quite noticeably and is now secure in the persons of 1,269 instructors approved by the Department. Of this number, 622 are members of gun clubs, 96 are school teachers, and 551 are listed as "private." The

Table I CAUSES OF HUNTING ACCIDENTS IN 1970

1.	Victim out of sight of shooter	22 %
2.	Shooter stumbled and fell	14 %
3.	Other or unknown cause (includes 3 self-inflicted)	14 %
4.	Victim mistaken for game	11.5%
5.	Trigger caught on object	11.5%
6.	Victim covered by shooter swinging on game	6 %
7.	Unloading firearm	5 %
8.	Improper crossing of obstacles	4 %
9.	Defective firearm	3 %
10.	Victim moved in line of fire	3 %
11.	Firearm fell from insecure rest	3 %
12.	Clubbing cover or game	1 %
13.	Horseplay with loaded firearm	1 %
14.	Loading firearm	1 %
15.	Removing firearm from or placing firearm in vehicle	0 %
16.	Riding with loaded firearm	0 %

Table II NUMBER OF MAN-DAYS SPENT HUNTING DIFFERENT SPECIES OF GAME

Species	Man-Days	No. of Accidents	Man-Days Per Accident
Moose	490,000	3	163,333
Ducks & Geese	1,371,000	11	124,363
Grouse	1,293,000	13	99,462
Rabbit	1,020,500	17	60,030
Pheasant	224,000	5	44,800
Deer	500,000	12	41,667
Total	4,898,500	61	80,303

number changes frequently as new men come along and older instructors drop out.

Today, the instructor is assisted with classroom aids, and a new and improved manual will be issued in the near future. All instructors are active and give training at reasonable intervals. All are tested and re-tested every three years.

The success of the educational program depends on the sincere efforts of these certified instructors. Many thousands of people have been trained, and hunting accidents have been reduced through the efforts of this volunteer group.

As a result of hunter training, the safety picture is encouraging. In 1960, there were 146 accidents (34 fatal), an average of 27 per 100,000 licences. In 1970, there were 78 accidents (8 fatal), an average of 13 per 100,000 licences.

Another way of looking at accident rates is to compare the number of man-days spent hunting various species with the number of accidents as shown in Table II.

Hunting is seen to be a relatively safe pastime when compared with routine activities. For 1969, the Workmen's Compensation Board of Ontario reports 110,951 lost-time accidents on the job in industries where the covered employees worked a total of 494,359,158 man-days—an average per accident of 4,456 man-days or 12 man-years. The work accident frequency rate was 22.3.

For hunters in Ontario in 1970 (Table II), the corresponding averages per hunting accident were 80,303 man-days or 220 man-years. The hunting accident frequency rate was 1.2. By more than 18 times over, our average hunter-worker is safer in the field than he is at work.

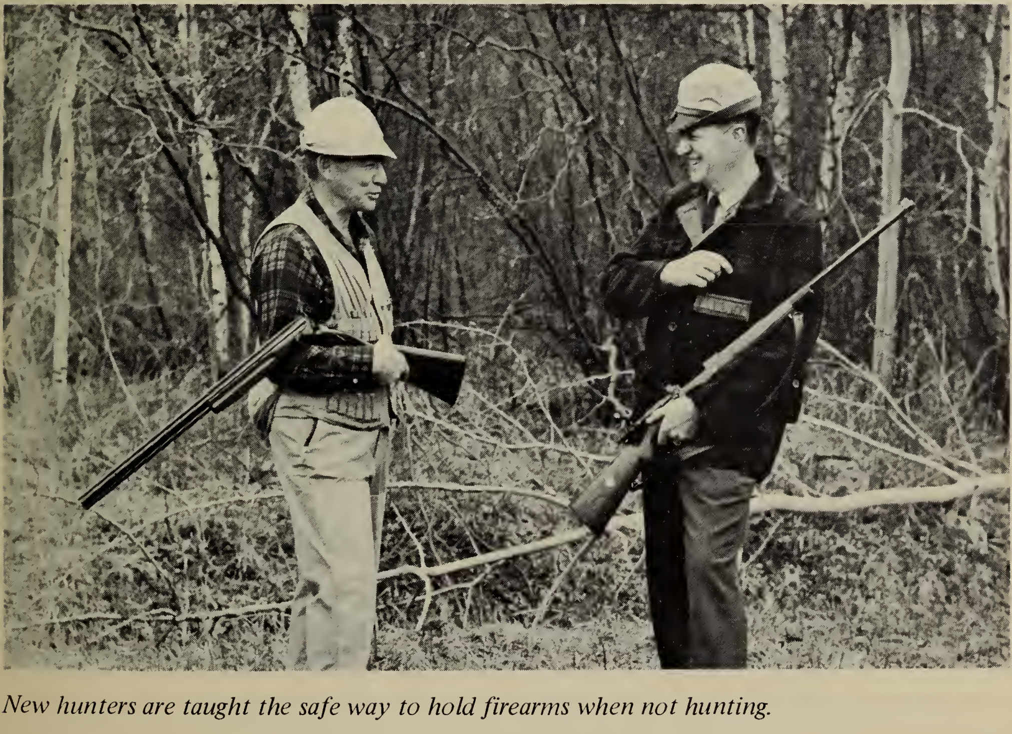
SAFETY IS SELF-CONTROL

Training alone cannot stop accidents. Hunters must practise self-control. A hunter naturally focusses on shooting game. Even an experienced woodsman may be under strong emotional stress. All his senses are turned to locating and bagging game. Each rustle of leaves, each snapping twig, or the smallest movement seen from the corner of his eye, may trigger the full intensity of his heightened awareness. Unless he holds himself in check very deliberately, he may react by shooting at the slightest movement or sound. A good hunter must have complete control of his reactions, and this is only developed by experience with the game he hunts.

Firearm control comes with practice. By handling his firearm properly at all times and waiting to see the game, the hunter will train himself to habitual control. Good habits, once established, will take over naturally when he is in the grip of excitement. Self-control is largely acquired. It should be practised at all times in the hunting field.

The following frequently quoted rules have been adopted over the years as the

New hunters are shown how a firearm operates and how it must be handled for safety.



New hunters are taught the safe way to hold firearms when not hunting.

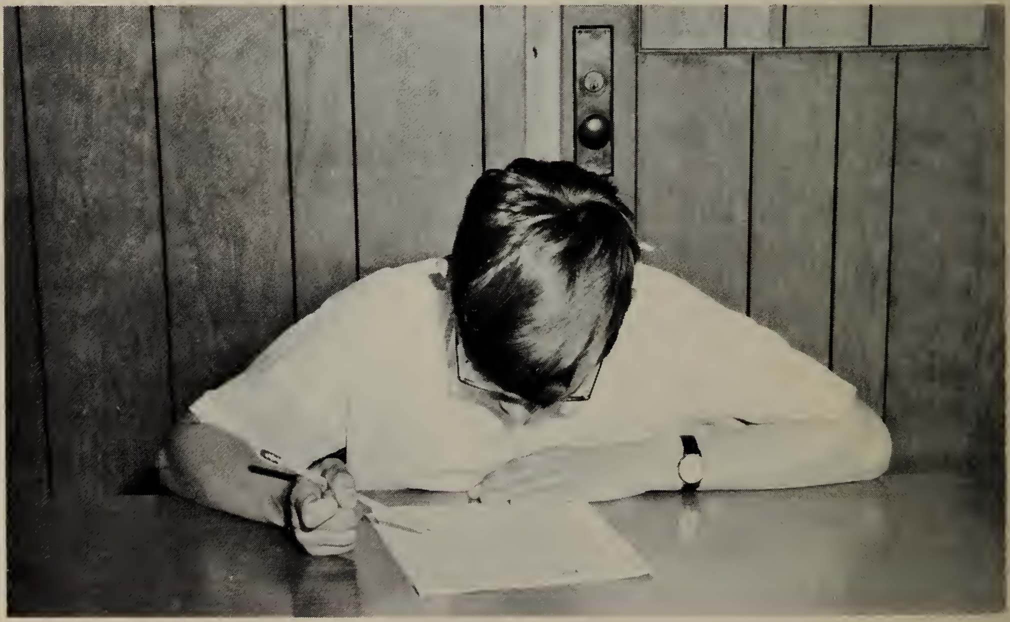
"Ten Commandments" of hunter safety.

1. Treat every gun as if it were a loaded gun.
2. Be sure of your target before you squeeze the trigger.
3. Never point a gun at anything you do not want to kill.
4. Always carry your gun so that the muzzle is under control.
5. Guns must always be unloaded when carried into camp or when not in use.
6. Make sure that barrel and action are clear of obstructions.
7. Unattended guns should be unloaded.
8. Never climb a fence or jump a ditch with a loaded gun.
9. Never shoot at flat or hard objects or the surface of water.
10. Avoid alcoholic drinks while hunting.

Now let's examine some of the past accidents to justify preaching these Ten Commandments.

1. Hunter picked up a loaded firearm by the barrel and passed it to another person with the muzzle pointing at himself. Firearm accidentally discharged hitting himself in stomach.
2. Hunter placed a loaded firearm in a vertical position against the side of a car. Firearm fell and discharged hitting victim in leg.
3. Hunter shooting at running rabbit in brush hit victim who was standing beyond rabbit.
4. Hunter while running with a loaded firearm to a better location for a shot at a deer, stumbled and fell, dropped firearm, hit self in arm.
5. Bear hunter sees a black object at base of tree, thought it to be bear. Hit victim in back.
6. While crossing a fence with a loaded firearm it became entangled and accidentally discharged hitting self in foot.

Most hunting accidents can be attributed to human carelessness or plain stupidity. The figures for the past decade show that one-third of the hunting accidents are self-inflicted. If we deduct these from the total and again compare it with the millions of man-hours spent in this recreation, we can only conclude that hunting is a safe sport. We will never eliminate accidents, but if we can prevent one injury or death, Ontario's hunting safety program is worth the effort.



A youthful candidate ponders the Hunter Safety examination. Photo by T. Jenkins.

FISH CULTURE—FROM ART TO SCIENCE

by K. J. Chambers
Biologist, Commercial Fish and Fur Branch

Our inland fisheries were once among the richest in the world. They supported vast numbers of the most desirable species, so abundant and easy to catch that fish formed a staple in the diet of both the native inhabitants and our early settlers. Witness a notice in the Gazette of York, May 16, 1798:

"To be sold by public auction on Monday, the 2nd of July next, at John McDougall's hotel in the town of York, a valuable farm situated on Yonge Street about twelve miles from York on which is a log house and seven or eight acres well improved. It affords an excellent salmon fishery, large enough to support several families."

As settlement expanded, our massive stocks of fish suffered rapid depletion through dam construction, land-use changes, pollution, excessive fishing, and just plain ignorance. Our lake sturgeon were once considered unfit for food, and they were purposefully destroyed by vengeful fishermen when they became entangled in netting gear and damaged valuable equipment.

The Atlantic salmon of Lake Ontario were reduced by commercial fishing and ultimately doomed by stream obstructions and the silting of their spawning beds. Of late, the predacious sea lamprey caused the collapse of an already waning lake trout industry after the Welland Canal gave it access to the upper Great Lakes.

As fish declined in numbers and in relative importance as a source of food, the gradual increase of leisure time brought the sports angler into a position of prominence. In earlier years, sportsmen were only interested in fish species of the highest repute. However, once our salmon had all but disappeared and our trout fisheries had degenerated significantly, the sporting demand shifted to species that were more readily available.

Regulations were passed on behalf of the sportsmen to withdraw specific, desirable species from the commercial class. The sale of maskinonge, for example, was prohibited in 1904. Before this date, hundreds of thousands of pounds of this valuable species had been removed from Lake Simcoe, alone.

Restrictive legislation did not solve the problem. Excessive fishing appeared to have caused serious declines in species that were formerly of no economic importance. This led in turn to additional measures to protect the fish and restore their numbers. Sanctuaries were established, and restrictions of commercial and sport fishing gear were attempted. Almost everywhere, these actions failed to save the fish.

At this time, when there was a general ignorance of what is presently termed 'fishery science', and when efforts to restore the fisheries met with disappointing results, a great new hope was generated by exciting stories from Europe about successes in the artificial propagation and culture of trout. Actually, it was an old story.

The art of raising fish can be traced to at least 2100 B.C. when the Emperor of China appointed instructors in fish culture and further regulated the time when fish spawn could be taken. In 475 B.C., Fan Lai wrote

the first complete treatise on the rearing of carp. The rearing of trout can be traced through recorded history as follows.

In 1420, Dom Pinchon (French) discovered a process of hatching naturally spawned trout eggs.

In 1741, S. Ludwig Jacobi (German) was credited with the discovery of a technique for the artificial fertilization of trout spawn.

In 1844, Remy and Gehin (French) independently rediscovered the method of artificial fertilization and successfully reared thousands of trout from artificially fertilized eggs.

In 1850, Coste, a professor, influenced the government to establish the first government-supported fish hatchery (piscifactory) at Huningue, France.

In 1856, V. P. Vrasski (Russian) developed and introduced the dry impregnation method for egg fertilization, significantly increasing egg survival.

In 1857, R. Nettle, the first active fish culturist in Canada, established his hatchery operations on the St. Charles River near Quebec City.

In 1858, Dr. T. Garlick and Professor H. A. Ackley, pioneers of fish culture in the Americas, established the first American fish farm near Cleveland, Ohio.

In 1864, Seth Green operated a hatchery at Caledonia, New York. In 1868, his station was taken over by the State of New York. In 1870, Green published a book, entitled "Trout Culture", which is now a collector's item.

In 1866, Sam Wilmot built a small hatchery on Wilmot Creek, near Newcastle in Durham County, Ontario. This followed years of experimentation in his home. In 1867, he received support from the Government of Canada.

In 1868, Wilmot established a full-scale hatchery operation. During the next 50 years, the Wilmot Creek hatchery produced over 155,000,000 fish of various species, the most prized of which was the Atlantic salmon of Lake Ontario.

From this period on, the development of fish hatcheries in North America became hectic. Ontario, alone, operated 30 stations in 1926, and the position of fish hatchery manager became one of prestige.

The exuberance for introducing hatchery reared fish was carried to extremes and with blind enthusiasm. The object was mass production, and little thought was given to evaluating the contribution to the resource.

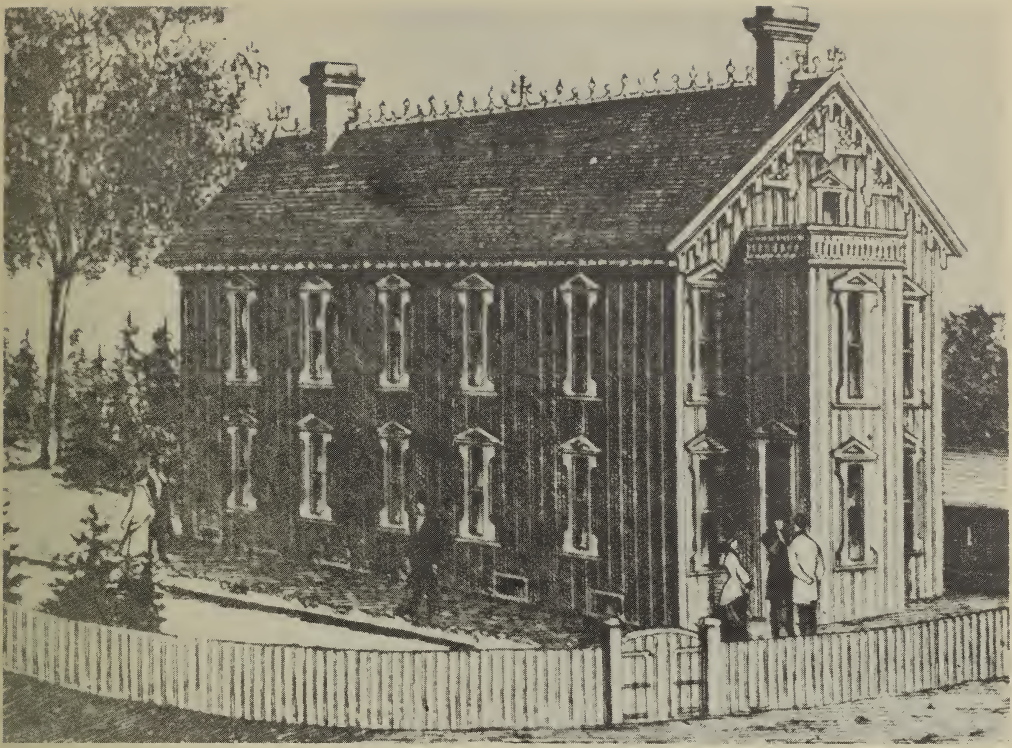
Towards the end of the century, improvements in modes of travel led to the widespread distribution of various fish species and the introduction of exotic species. Many of these introductions failed; some succeeded; and some succeeded too well. The representative Ontario examples, respectively, were the Arctic grayling, the rainbow trout, and the carp.

Early promoters offered fish culture as a cure-all for fisheries problems everywhere. Animal husbandry had led to great improvements in domestic animals. Why then, they reasoned, wouldn't fish culture improve our fisheries and flood our waters with fish?

One critical factor was neglected. Domestic animals live in controlled environments, but fish, reared under artificial conditions, must face the resistance of the hostile environment into which they are released. Indeed, countless millions of hatchery reared fish succumbed to cannibalism, predation, thermal shock, dietary deficiencies, and numerous other lethal influences which were not well understood by early fish culturists.

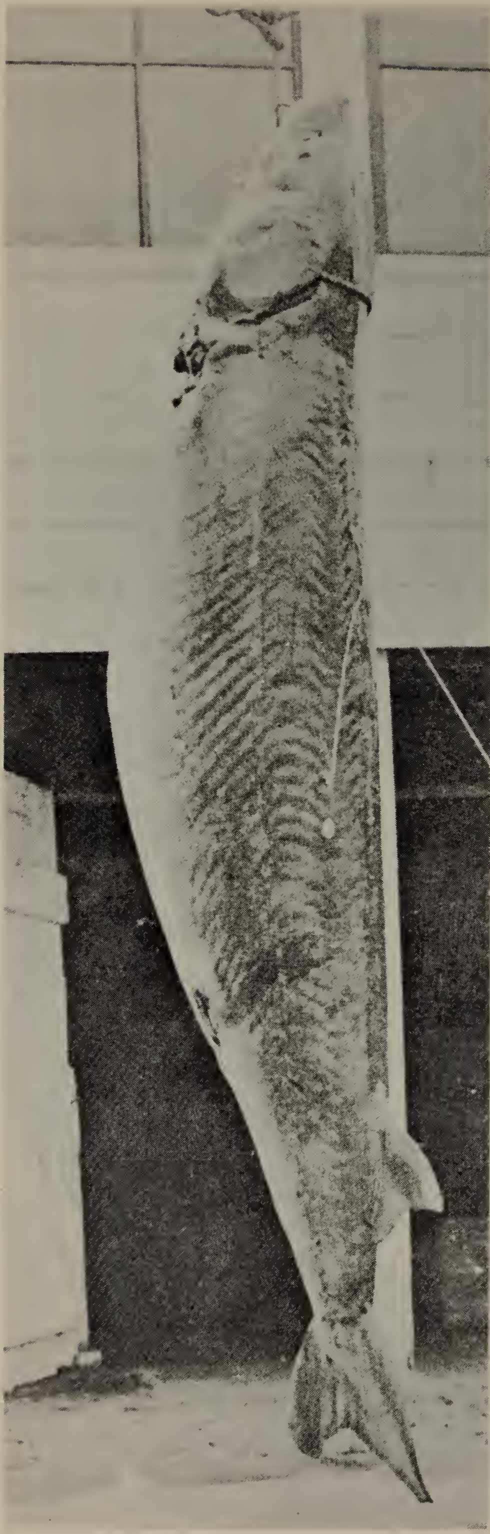
It became obvious that fish culture was not producing the anticipated results. A study of the problem revealed what nowadays appears to be obvious—the specific habitat and environmental requirements of the species must be known, and the environment into which they are introduced must match them closely before planting success can be predicted.

In too many cases, hatchery fish have been used as biological indicators—if the fish



Ontario's first fish hatchery, Newcastle, 1887. It failed in its major project, the restoration of Atlantic salmon in Lake Ontario.

The museum in the Newcastle hatchery, 1887.



A 230-pound sturgeon, 6'8" in length, taken in 1946 in the Niagara River.

survived, then the habitat was suitable! Perhaps the most common example of this wasteful practice was the planting of brook trout in ponds and lakes which commonly reached lethal oxygen and temperature levels.

In retrospect, early fish culturists in Ontario did not noticeably improve our fisheries as a whole. However, they did develop techniques and accumulate knowledge of our fishes and their physical requirements. As a result, fish culture finally found its true place in the broad field of fisheries management.

Where, then, do we stand today?

In the hatcheries of the Department of Lands and Forests, the emphasis is on quality, rather than quantity. For recreational fishing, particularly, it is recognized that fish stocks should have all the best qualities of their wild relatives. Experimentation with potentially adaptable exotic species is cautious, and all factors are studied intensively before management plans are initiated.

Our main effort is toward salmonid culture. The salmonids (trout, char and salmon) are among the most prized of our native fishes. They are, however, highly sensitive to the environment and less easily managed than some other species. For example, when bass are planted in suitable waters, the result is generally an immediate self-sustaining fishery, and subsequent plantings may be compared to the addition of water to an already full bucket.

Nonetheless, the judicious planting of trout (in waters which do not sustain natural reproduction) can yield excellent fisheries for short periods of time and produce benefits far exceeding the original cost. The use of waters barren of competing or predacious species, or the reclamation* of suitable

The first steps in fish culture—a spawning female yellow pickerel on the left and a milting male on the right. Photo by T. Jenkins.

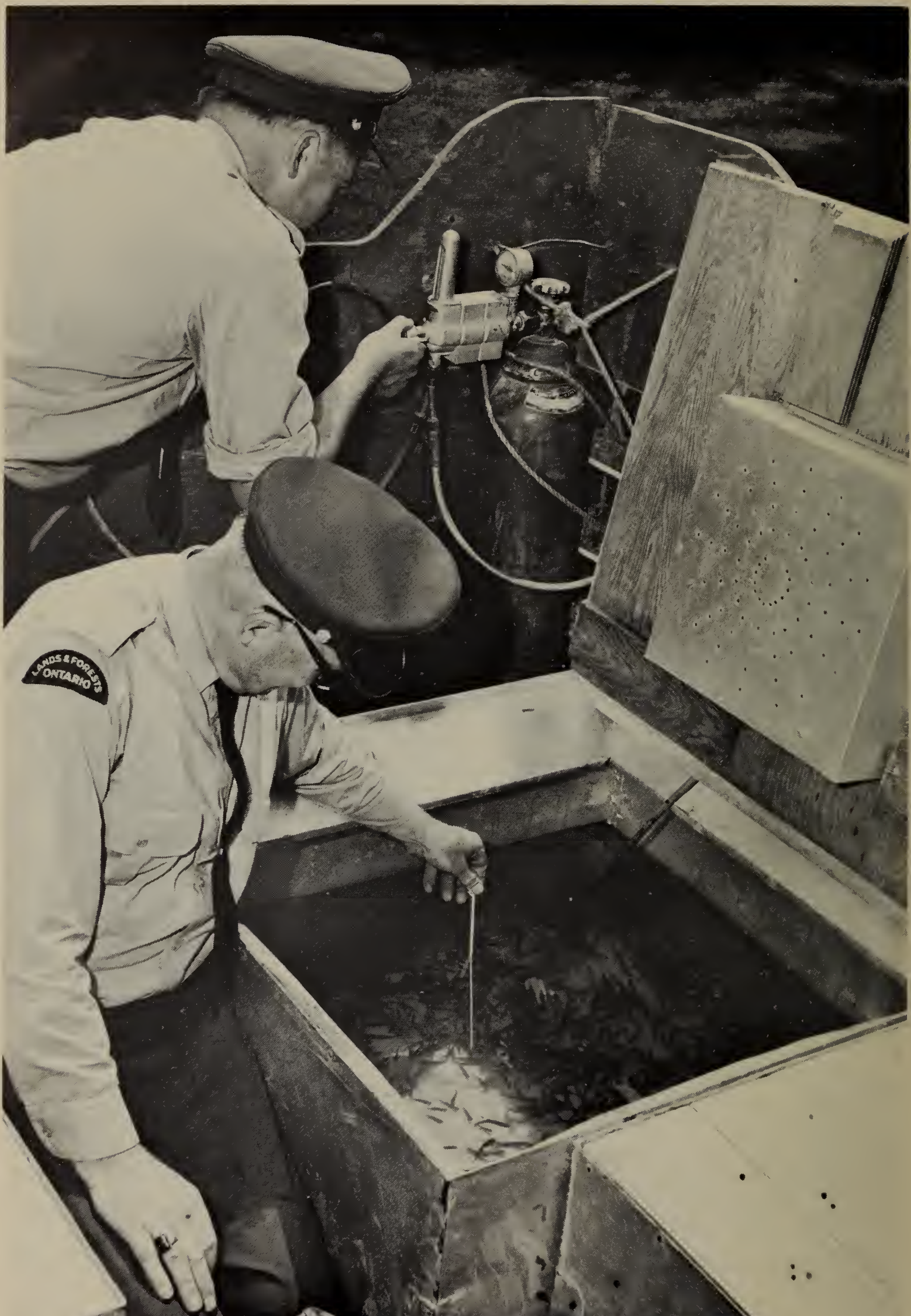
waters, have become recognized management procedures for creating high-quality salmonid fisheries.

A salmonid of particular interest is the splake, a highly selected hybrid of lake trout and brook trout developed by the Department to fill a niche no longer habitable by the lake trout. The latter grows slowly and matures late, and it cannot survive or sustain its numbers where sea lamprey populations are strong. The splake has been selected for rapid growth, early maturity and deep swimming ability. It was designed specifically to survive and reproduce naturally in waters inhabited by sea lamprey.

Hatchery fish are generally planted at a larger size nowadays. It has been learned that the larger the fish at planting, the greater its change of survival. This is related in part to the severe mortalities suffered by all species in their first year of life. At present, the department is experimenting with the use of second-year lake trout where the yearling plantings have failed consistently. Preliminary trials with the larger stock allow us to be optimistic about this approach.

Other important factors in fish plantings include timing, water temperatures and planting techniques. Spring plantings have

**In fisheries management, reclamation refers to the chemical treatment of waters to eliminate all fish species, followed by the planting of a desired species—brook trout, for example.*



Adjusting the oxygen flow in a tank of splake fingerlings. Photo by D. Marshall.

about a three-to-one edge over fall plantings in fish survival. A temperature difference of more than ten Fahrenheit degrees, between the hatchery and receiving waters, can be lethal to the hatchery fish. Air-dropped fish show higher mortalities than fish planted at the water surface. In recent years, we have used helicopters to plant hatchery fish in inaccessible waters where fixed-wing aircraft cannot land.

To assist hatchery operations, we are presently investigating "through the ice" plantings but are pessimistic about the outcome. The success of these plantings must be measured, not in terms of the immediate saving in time and dollars, but in terms of the survival of hatchery fish until harvested by the angler.

The measurement of the contribution of hatchery fish to a fishery is generally accomplished through the marking of the planted stock. Ontario's policy of fin-clipping all markable-size fish has contributed significantly to our knowledge of these fish. Net sampling, creel census and commercial-catch monitoring provide the information which is assessed for management planning. The failure of a planting dictates a follow-up study to identify the reason, or reasons, for the failure.

At planting time, the bulk transfer of live fish is no easy accomplishment. Crowded and excited far beyond any normal condition, the fish must be provided with all the necessities for life support and reach their destination with sufficient vitality to survive and thrive in a new and strange environment. One remarkable success in this regard was the transfer of fifteen lake sturgeon, weighing from six to eight pounds each, from our Westport hatchery to Moscow for experimental genetic studies.

In fish transport technology, the once common milk-cans are being replaced by highly efficient, sealed plastic bags containing an atmosphere of pure oxygen. For major transfers, aerated or oxygenated tanks are used. Recently, the Department acquired a specialized vehicle for the movement of planting stocks.

At the hatcheries, fish diets have changed radically as a result of exhaustive research into the nutritional requirements of fish. Traditionally, the fish food at large hatcheries was ground beef liver, expensive to buy and difficult to prepare and feed. Today, this diet is only used to supplement pelletized trout feeds. The food-growth conversions with this latter feed are remarkable and have been measured at 1.2–one pound of fish produced per 1.2 pounds of feed.

A striking indication of the wide acceptability of the dry diet was demonstrated in the feeding of yellow pickerel (walleye) fingerlings. Although normally cannibalistic and carnivorous, feeding only on live prey, they now can be reared on an exclusive diet of dry trout feed.

Hatchery managers are hyperconscious of disease risks. Indeed, fish diseases and parasites are far more dangerous within the confines of a hatchery than they are in wild waters. The natural resistance of the fish is reduced through crowding and the associated abnormal stresses. Fungus attacks the eggs; protozoans, bacteria and viruses affect the fry; and macro-parasites debilitate parent fish. Thus, diseases and parasites continue to plague hatchery managers, and their importance cannot be over-emphasized.

The sterilization of distribution and rearing tanks is routine at the hatcheries. Losses, which were significant in the past, can be controlled through the use of drugs, but the best protection still lies in prevention, not cure.

Fish culture is old and significantly important for increasing the production of fish for food and recreation. Technological developments indicate that it is emerging from a practical art into a true science. Although there is still much to learn, fish culture is certainly established today as an important tool of fisheries management when it is used with discretion and intelligence.

Bright orange fluorescent signs direct hunters to the Red Lake Road check station.

A Photo Story

RED LAKE ROAD CHECK STATION

Photos by Cees Van Gemerden

In Kenora Forest District near the village of Red Lake Road, the Department of Lands and Forests annually sets up a hunter's check station during the fall hunting season. This is one of about fifteen such stations strategically located along access routes to the big game hunting areas of Ontario.

These check stations play an important part in the collection of biological data. For each area checked, such factors as fertility, age, sex and physical condition are assessed by biologists who can then improve the management of game species through a better understanding of their productivity, population dynamics and nutritional requirements.

Aside from biological data, other useful information is gathered at the check stations. The hunters are asked to fill out questionnaires about themselves with respect to the amount of time and money they spend on hunting trips and other social and economic data. Their answers provide useful information for planners in the area so that natural resources and man's varied interests in them will be wisely accommodated in years to come.

The many hunters checking in with their game make the station a busy place. As the above sample shows, a wide assortment of vehicles and equipment are used on hunting trips. In the left foreground is the weigh scale.

The Red Lake Road station is open day and night during the hunting season.

Wildlife biologists measure and record a trophy moose rack. They may remove the lower jaw of a non-trophy head to judge the animal's age from an examination of its teeth. Two front teeth are extracted from the lower jaw of a trophy animal to determine its age.

Hunters are asked to donate the ovaries of cow moose and doe deer to the Department of Lands and Forests. Biologists can then determine the number of young conceived by the females over the years. This information is related to such factors as food supply and is invaluable to future management programs.

A co-operative hunter donates the lower jaw of a moose he has shot. In return, he receives a "Successful Moose Hunter" crest from the Department of Lands and Forests.

Each member of a hunting party is requested to fill out a questionnaire. This gives the Department some of the economic and social information needed to plan the future use of the area. Check Station staff are on hand to help out.